

What is claimed is:

1. A disk drive having a rotatable magnetic recording disk with a plurality of concentric tracks and a recording head movable across the disk for reading and/or writing data in the tracks, and wherein the tracks contain servo information detectable by the head, the disk drive comprising:

a primary actuator for moving the head;

a secondary actuator connected to the primary actuator, the head being connected to the secondary actuator;

a servo control processor responsive to servo information detected by the head, the servo control processor comprising a dual-stage controller for simultaneously generating a primary actuator control signal and a secondary actuator control signal, and a single-stage controller for generating only a primary actuator control signal, said single-stage controller being selectable by the processor in response to failure of the secondary actuator.

2. The disk drive of claim 1 wherein the dual-stage controller comprises a degraded-stability primary actuator controller having relatively high low-frequency open-loop gain, and a secondary actuator controller providing stability to the dual-stage controller.

3. The disk drive of claim 2 wherein the servo control processor includes a model of the dynamic response of the primary actuator and a model of the dynamic response of the secondary actuator, the models providing a modeled head-position output when the controls signals from the dual-stage controller are input to the models.

4. The disk drive of claim 3 wherein the single-mode controller is selectable by the processor when the difference between the modeled head-position output and the measured head position from the servo information detected by the head is greater than a predetermined value.

5. The disk drive of claim 3 further comprising a secondary-actuator relative-position sensor coupled to the servo control processor.

6. The disk drive of claim 5 wherein the secondary-actuator model provides a modeled output of the position of the secondary actuator relative to the primary actuator when the secondary actuator control signal from the dual-mode controller is input to the secondary-actuator model, and wherein the single-mode controller is selectable by the processor when the difference between the modeled secondary-actuator relative position and the measured relative secondary-actuator position from the relative-position sensor is greater than a predetermined value.

7. The disk drive of claim 5 wherein the secondary actuator is an electrostatic microactuator and the relative-position sensor includes a capacitance sensing circuit coupled to the microactuator.

8. The disk drive of claim 1 wherein the secondary actuator is a piezoelectric actuator.

9. A disk drive having a rotatable magnetic recording disk with a plurality of concentric tracks and a recording head movable across the disk for reading and/or writing data in the tracks, and wherein the tracks contain servo information detectable by the head, the disk drive comprising:

a voice-coil-motor (VCM) for moving the head;

a crash stop for limiting movement of the VCM;

a microactuator connected to the VCM, the head being connected to the microactuator;

a servo control processor responsive to servo information detected by the head, the servo control processor comprising a dual-stage controller having a degraded-stability VCM controller with relatively high low-frequency gain and a microactuator controller for simultaneously generating a VCM control signal and a microactuator control signal, and a single-stage controller for generating only a VCM control signal, said single-stage controller being selectable by the processor in response to failure of the microactuator.

10. The disk drive of claim 9 wherein the servo control processor includes a model of the dynamic response of the VCM and a model of the dynamic response of the microactuator, the models providing a modeled head-position output when the controls signals from the dual-stage controller are input to the models.

11. The disk drive of claim 10 wherein the single-stage controller is selectable by the processor when the difference between the modeled head-position output and the measured head position from the servo information detected by the head is greater than a predetermined value.

12. The disk drive of claim 11 wherein, if the single-stage controller is selected and the VCM is biased against the crash stop, the dual-stage controller is selectable by the processor when the difference between the modeled head-position output and the measured head position from the servo information detected by the head is less than a predetermined value.

13. The disk drive of claim 10 further comprising a microactuator relative-position sensor coupled to the servo control processor.

14. The disk drive of claim 13 wherein the microactuator model provides a modeled output of the position of the microactuator relative to the VCM when the microactuator control signal from the dual-stage controller is input to the microactuator model, and wherein the single-stage controller is selectable by the processor when the difference between the modeled microactuator relative position and the measured relative microactuator position from the relative-position sensor is greater than a predetermined value.

15. The disk drive of claim 14 wherein, if the single-stage controller is selected and the VCM is biased against the crash stop, the dual-stage controller is selectable by the processor when the difference between the modeled microactuator relative position and the measured relative microactuator position from the relative-position sensor is less than a predetermined value.

16. The disk drive of claim 13 wherein the microactuator is an electrostatic microactuator and the relative-position sensor includes a capacitance sensing circuit coupled to the microactuator.

17. The disk drive of claim 9 wherein the microactuator is a piezoelectric microactuator.

18. The disk drive of claim 9 wherein, following selection of the single-stage controller in response to failure of the microactuator, the control signal to the VCM from the single-stage controller moves the VCM to the crash stop.

19. The disk drive of claim 18 wherein, with the VCM biased against the crash stop and an excitation control signal applied to the microactuator, the single-stage controller remains selected if the microactuator has failed.

20. The disk drive of claim 18 wherein the single-stage controller is permanently selected if the VCM is moved to the crash stop more than a predetermined number of times within a predetermined time period.